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THE EFFECTIVENESS OF ADJUNCT AUTO-INSTRUCTION.

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THE EFFECTIVENESS OF USING ADJUNCT AUTOINSTRUCTIONAL MATERIALS FOR COLLEGE-LEVEL TEACHING AS COMPARED TO USING--(1) CONVENTIONAL MATERIALS AND (2) AVAILABLE PROGRAMED MATERIALS FOR SUCH ACTIVITY WAS TESTED. (ADJUNCT AUTOINSTRUCTIONAL PROGRAMS OPERATE ON THE ASSUMPTION THAT THE LEARNER IS AN ACTIVE PARTICIPANT, AND MATERIALS AND PROCEDURES ASSOCIATED WITH SUCH PROGRAMS ARE DESIGNED TO--(1) CLARIFY AND EXTEND MEANINGS, (2) CORRECT MISUNDERSTANDINGS, (3) CONFIRM STUDENT CHOICE, (4) POINT OUT STUDENT ERRORS, AND (5) GUIDE STUDENTS TO CORRECT ANSWERS.) THESE AUTOINSTRUCTIONAL MATERIALS WERE DEVELOPED FOR AND EVALUATED IN A COLLEGE COURSE ENTITLED "HUMAN GROWTH AND LEARNING." THE MAJOR CRITERIA FOR EVALUATING MATERIAL EFFECTIVENESS WERE--(1) LEARNING TIME TAKEN AND (2) AMOUNT LEARNED. OVER 230 STUDENTS ENROLLED IN THE COURSE WERE SELECTED FOR EXPERIMENTAL AND CONTROL GROUPS. THE EXPERIMENTAL TREATMENT CONSISTED OF LEARNING EXERCISES IN COMBINATION WITH A "TRAINER-TESTER RESPONSE CARD" WHICH PROVIDED IMMEDIATE KNOWLEDGE OF RESULTS AND THE OPPORTUNITY TO RECOGNIZE IMMEDIATELY RIGHT FROM WRONG RESPONSES. THE CONTROL TREATMENT USED LEARNING EXERCISES WITH A CONVENTIONAL ANSWER SHEET. MULTIPLE-CHOICE ITEMS WERE USED FOR TESTING. THE EXPERIMENTAL GROUP MADE SIGNIFICANTLY HIGHER SCORES ON CHAPTER POST-TESTS (CONSISTING OF IDENTICAL, BUT REARRANGED, ITEMS TO THOSE OF PRETESTS ADMINISTERED EARLIER). THE TWO GROUPS DID NOT SIGNIFICANTLY DIFFER, HOWEVER, WHEN MEASURED BY MIDSEMESTER TESTS AND THE FINAL EXAMINATION. (SEE ED 003 386 FOR FURTHER INFORMATION.) (JH)

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THE EFFECTIVENESS OF ADJUNCT AUTO-INSTRUCTION

Cooperative Research Project No. 2306

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I. Introduction

The project was devoted to the development of auto-instructional materials and the evaluation of these materials as learning aids in a college course entitled "Human Growth and Learning". The content of this course is primarily what is usually considered within the field of educational psychology. The course is required of all students in the College of Education at the University of Arizona.

One of the topics in present-day educational psychology covers the use of teaching machines, programed instruction in various forms, the use of language laboratories and other media as aids to learning. The investigators are working in the field of educational psychology and it was very convenient to use the subject-matter available to try out adjunct auto-instructional materials as an alternative to programed materials and to integrate the research on such media into the content of the above-mentioned course.

Programed instruction has been hailed as one of the greatest educational advances since the invention of printing. The present research is premised on the notion that such grandiose claims should be challenged. Critical studies report that programed instruction is often no more effective than usual methods of presentation and almost always more clumsy and expensive (10, 7).

One thing has emerged from the research on programed instruction, namely, that the objectives of learning exercises must be kept clearly in view. The belief that learning exercises and sequences can

be improved and the additional belief that an alternative to presentations of small units can be developed has led the investigators to work on the notion that one can take advantage of the order or structure which exists in textbooks or other reading material. Also, adjunct auto-instructional materials take advantage of the classroom discussions and presence of the instructor as motivator and clarifier of ideas.

Psychologists have known for many years that practice with knowledge of results is usually superior to practice without such knowledge. For considerable time there have been both theoretical and practical studies aimed at the development of devices and procedures by which the learner could be made aware immediately of the accuracy of his responses and the effect of this feedback on his learning determined. Two lines of progress have given recent impetus to research concerning such instruments. One is the amazing success of such investigators as Skinner in training animals, for example, pigeons, through systematic and immediate reinforcement, to perform tasks hitherto thought to be beyond their abilities. Second, the development of computers and mechanical aids has found the public ready to accept procedures which would train or educate by mechanical means. Hence, there has been both theory and equipment available to investigate the possibility of mechanizing instruction.

Skinner, together with many others, became disturbed with the slowness with which children learn the elementary subjects, the number of errors which persist in their learning, and the fact that in most schools children are held to a pre-determined rate of progress geared for the

average, instead of being allowed to go at their own rates. He tried methods similar to those used for animals to train children in some of the regular school subjects. Later the same techniques were applied to work at more advanced levels. These processes have yielded, at least temporarily, some good results, and with the rather typical American enthusiasm for trying new things there has been an enormous development of programing, teaching machines, and other devices to assist learning in almost every conceivable field.

In the most extreme form these programs assume that the learner is completely naive with respect to the task to be accomplished. He has no previous background of experience to aid him in its performance. The pigeon has no knowledge at the outset of what it is supposed to do. The task is set entirely by the experimenter. The completion of one unit has no necessary relevance to the performance of the next one. There is no opportunity (perhaps it is assumed there is not the ability) to view the entire operation, the anticipated goal, or the reason which makes the goal desirable. Such assumptions operate in much of animal learning and there have been, perhaps, some educational programs which approximate them.

Many psychologists, however, think that methods of promoting learning in lower animals are not necessarily those most adequate for use with human beings. Most of the present programs used in schools have departed from the extreme procedure mentioned above although many do hold that the main task is to construct in a rather routine fashion specific responses with equally specific stimuli. Other plans emphasize in varying

degrees the cognitive participation of the learner, the value of covert as well as overt response, and the desirability of structuring the learning situation.

Adjunct auto-instructional programs operate on the assumption that the learner is an active participant. His background is considered. It is assumed that he knows what he is doing, why he is doing it, and operating with structured material so that the completion of one unit has some relation to the total learning situation.

Adjunct Auto-Instruction Defined

Perhaps the best discussion of the meaning of adjunct auto-instruction is given by Pressey (6). He states that adjunct auto-instructional procedures are designed to clarify and extend meanings, to correct misunderstandings, to confirm the student's choice, to point out his errors, and guide him to the correct answers.

Adjunct auto-instruction assumes that the student has some understanding of the task and that he has already made some effort to deal with it, that he has read some textbook material, listened to a lecture, or has participated in some relevant activity. Adjunct auto-instruction does not substitute for a text nor eliminate the instructor. It assumes, and there is much evidence to support the assumption, that much material can be learned, and learned more economically, just by reading and that in this reading not only does the student derive information and understanding but he becomes aware of the purpose of the discussion, and something of the structure of the exposition. Then, with much already being understood,

adjunct auto-instruction will aid on the elements of greater difficulty. Questions ordinarily used to measure the result of reading are primarily test questions, not instructional ones. Instructional questions, on the other hand, are to aid the student at the time of learning. They not only provide feedback they feed into and forward. If the answer be incorrect the adjunct auto-instruction will not only so inform him but will suggest to him the correct answer. Frequently this purpose is well served by multiple choice situations where the learner will more clearly appreciate the correct answer by seeing it in contrast with the incorrect one. Adjunct auto-instruction will be used, then, in situations where the student is an active participant in what is to him a meaningful learning experience. It will aid him as a good teacher does. It will not displace the teacher but will help him to put his efforts at those points where clearing up of major difficulties and where extended meanings will yield greatest results.

The problem to be investigated in this study is not the efficacy of immediate knowledge of results for the value of that is known and accepted. Rather, it is the combination of immediate knowledge of results with an awareness of the alternatives. This requires that the learner recognize error as error and correct response as correct response. This is essentially the difference between education and training.

The learning theory behind most programing efforts is that of instrumental or operant conditioning. Some human learning is operant learning but obviously some of it isn't. In this study the multiple choice format represents rather closely the situation one usually finds in complex,

human learning involving, as it does, choice among responses. Students in college level education courses should not be conditioned to give relatively invariant responses to stimuli. They are being taught that any one of several responses might be proper in some situations, and that one response might be a "best" response under certain circumstances. The multiple-choice item as designed in this study represents the adjunct auto-instructional situation thought to be most conducive to learning that is peculiarly human in character and not mechanical or reflexive.

II. Preliminary Investigations and the Development of Materials

At the beginning of the project it was agreed that the instructional materials should be of the pencil and paper type, be relatively inexpensive, and should provide immediate knowledge of results.

Several preliminary studies had been performed by the senior author before the current project was proposed and led to some of the questions which were to be investigated in the present study. These studies have been reported elsewhere (8, 9).

The chief findings of these studies led the investigators to believe that auto-instructional, or as sometimes called, auto-elucidative questions, can be incisive and time-saving; they can take advantage of feedback or immediate knowledge of results without fragmentation into very small frames; and questions of this type can take advantage of the already present structure of written material. Also, it led the investigators to assume that most human learning at least at the school level is not a matter of starting from a point of complete ignorance, but that there is usually something upon which to build new knowledge.

The course, Human Growth and Learning, used as text materials Lee J. Cronbach's Educational Psychology (Second Edition) (3), Warren R. Baller's Readings in the Psychology of Human Growth and Development (2), certain other articles, and viewing of some films. From these materials certain chapters from Cronbach and Baller were used to develop adjunct auto-instructional exercises.

In addition, during the autumn semester of academic year 1963-1964

several techniques were tried for furnishing immediate knowledge of results. The three-choice multiple choice format of instructional question was used since the three-choice procedure has been found to be quite adequate for learning exercises of this type (4).

Extensive correspondence was exchanged with various persons engaged in experimentation and publishing materials providing immediate knowledge of results. In the meantime a homemade device which consisted of a dittoed sheet of questions with a space before each choice which was blackened with a soft pencil was used. Under this penciled overlay was the letter "R" for the correct response. Incorrect response spaces contained nothing under the overlay. The student was instructed to erase the blackened space in front of his choice of answer. The preparation of such sheets was much too laborious for extensive use. In spite of the inadequacy of this scheme some preliminary experimentation was carried out using this procedure.

Van Valkenburgh, Nooger, & Neville, Inc. provided especially for this project 3x5 cards containing spaces for 30 multiple choice questions using the three-choice format. These cards are referred to as Trainer-Tester Response Cards and are covered by patents of the above-mentioned company.

The exercises developed during the first semester were built by several different procedures. The test item file by Jacob S. Orleans prepared for use with Cronbach's Educational Psychology was used as a point of departure in the preparation of instructional items. Also, Drs. Orleans

and Cronbach made available some unpublished items which were adapted for use in this project. Open-ended questions were used in several classes to obtain responses which could be edited into satisfactory alternatives for the auto-instructional questions. Empirically determined misunderstandings are necessary material for preparing good instructional questions of the multiple choice type. Interviewing was not used as a source of obtaining such misunderstandings, although it was intended earlier that this be done.

Auto-instructional materials were developed to go with some concise printed explanations of some elementary statistical procedures. No experimental use was made of these materials but they were used for instructional purposes and served to acquaint students with auto-instructional procedures. Likewise, auto-instructional questions were developed on three short films on reinforcement but were not used under experimental conditions.

An article by Abraham Maslow "A Theory of Human Motivation" from Baller's Readings (p. 255-277) provides an example of the procedure used to develop good auto-instructional items.

A series of questions based on Maslow's article was prepared; some of these were short answers; some of them were multiple choice; some of them were factual; and some were the interpretative type. These questions were given to two sections of the course. From the results of this test another test of 34 three-choice items was prepared.

The article was assigned to two other sections and they were told

that a test would be given to them. On the following class period one section of the class was given the 34-item test with feedback. The other section was given the same questions in regular multiple-choice manner without feedback. Following this test both sections of the class discussed the assignment - the discussion arising out of questions which occurred on the test as well as other points of the article. The results of this 34-item test were analyzed and another test prepared containing 36 items of which 11 were repetitions from the previous test, 10 designed as items of application or interpretation, and 15 were new or rather definitely paraphrases of the original ones. The 11 items which were repetitions are items which were frequently answered incorrectly. Then, seven days after the 34-item test each of the sections was given the above-mentioned 36-item test.

On the eleven identical items of the 36-item test the experimental group (with feedback) made significantly ($p = .02$) fewer errors than did the control group. On the fifteen new and paraphrased items although the group with feedback made fewer errors the difference was not significant (five per cent level) nor was there a significant difference between the groups on the application questions although the non-auto-instructed made fewer errors. In terms of the total test the experimental group had significantly fewer errors than did the control group ($p = .02$).

III. The Second Semester Experiment

The Problem

The problem to be put to test in this controlled experimental situation is whether for multiple choice items the combination of immediate knowledge of results with awareness of right as right and wrong as wrong is more effective in producing learning than multiple choice items without immediate feedback and such awareness.

The criterion of effectiveness is the amount of learning as revealed by chapter post-tests, two mid-semester tests, and a final examination. Course grades were not used as one of the experimental variables, but test scores were.

Experimental Design

Two hundred thirty-three (233) students were enrolled in seven sections of the course "Human Growth and Learning," (Catalog designation Education 151) in the second semester, 1963-1964. Four sections of approximately equal size, two taught by one instructor and two by another, constitute the sample of students. The four sections were counter-balanced by instructor so that each of two instructors had one control and one experimental group. The other three sections taught by three different instructors served as a good proving ground for checking out items and exercises before the experimental and control groups used them. The students in these seven sections were considered to be a representative sample of students in the College of Education at the University of Arizona.

The four sections constituting the experimental and control groups

total 128 students. They were divided among two instructors as follows:

	Control Group	Experimental Group
Instructor A	39	31
Instructor B	26	32

All students were given at the outset a test of educational psychology knowledge (Pre-Test, Course) to determine whether these groups differed on amount of previously obtained information. Likewise the Otis Quick-Scoring Mental Ability Test, Gamma was given to all to determine the spread of academic aptitude as measured by a pencil and paper test of this type. In addition, a personal data inquiry was given to each student to obtain age, sex, college classification, major area, the number of semester hours in psychology, and the number of semester hours in behavioral sciences other than psychology.

The treatment received by the experimental group consisted of learning exercises in combination with a Trainer-Tester Response Card which provided immediate knowledge of results and the opportunity to recognize immediately right as right and wrong as wrong. The control group received the learning exercises with the conventional answer sheet.

Both control and experimental groups knew they were involved in a research project. All groups were given assignments over either textbook chapters or other readings with the understanding that there would be class discussions of the material. On the day of discussion both control and experimental groups were given a pre-test of adjunct auto-instructional items. After the discussion, usually at the following class meeting, a

post-test was given covering exactly the same material except the order of presentation was changed so that patterns could not be memorized. The control group always used conventional answer sheets, and the experimental groups responded on Trainer-Tester Response Cards which provided immediate confirmation of correctness of response. Eventually the control groups had an opportunity to check on the correctness of their responses.

Chapters 1, 2, 4, 9, 10, 17 and 18 in Cronbach were used in the above manner. A mid-semester test of 35 multiple choice items, another of 52 items and a final examination of 96 items were used to check retention and to see whether there was transfer to new items.

Two kinds of measurements were used for testing the hypothesis of no difference between the experimental and control groups: first, percentages for each item and second, scores for each individual. Both are based on student responses to the multiple choice items.

The percentages computed for each item of the chapter tests by group and considered for statistical analysis are:

1. Percentage of wrong responses on the pre-test which changed to right on the post-test.

2. Percentage of right responses on the pre-test which remained right on the post-test.

The scores for individuals which provided a basis for statistical tests of group differences were obtained from:

1. Pre-test, chapter one, number right responses.

2. Post-test, chapter one, number right responses.

3. Pre-test, chapter two, number right responses.

4. Post-test, chapter two, number right responses.

5. Pre-test, chapter four, number right responses.

6. Post-test, chapter four, number right responses.

7. Pre-test, chapter nine, number right responses.

8. Post-test, chapter nine, number right responses.

9. Pre-test, chapter ten, number right responses.

10. Post-test, chapter ten, number right responses.

11. Pre-test, chapters seventeen and eighteen combined, number of right responses.

12. Post-test, chapters seventeen and eighteen combined, number of right responses.

13. First mid-semester test, number of right responses.

14. Second mid-semester test, number of right responses.

15. Final examination, number of right responses.

16. Number of right responses on chapter pre-tests changed to wrong responses (R - W) on chapter post-tests (gain score).

17. Number of wrong responses on chapter pre-tests to remain wrong responses (W - W) on chapter post-tests (gain score).

18. Number of wrong responses on chapter pre-tests to change to right responses (W - R) on chapter post-tests (gain score)

19. Number of right responses on chapter pre-tests to remain right (R - R) on chapter post-tests (gain score).

The sign test (5), a non-parametric test, was used to test the hypothesis of no difference between experimental and control groups where the percentages for items were considered.

The scores for individuals were subjected to an analysis of covariance using the regression method (11) in order to test the hypothesis of no difference between groups. The variables considered in covariance for the various analyses were:

1. Age, in years
2. Grade point average
3. Otis Gamma
4. Hours, Psychology
5. Hours, Behavioral Sciences other than Psychology
6. Pre-Test, Course (knowledge of educational psychology)
7. Pre-Test, chapter (appropriate to analysis)
8. Instructor
9. Sex
10. Classification: junior, senior, or other
11. Major Area: elementary, secondary, or other

IV. Results

The problem to be put to test is whether for multiple choice items the combination of immediate knowledge of results with awareness of a right as right and wrong as wrong is more effective in producing learning than the multiple choice items without immediate knowledge of results and such an awareness.

Tests of the hypothesis of no difference between the two groups, experimental and control, were based on two kinds of measurements: percentages computed by item and chapter, and scores for individuals.

Analysis of Percentages for Items

Consider for each group, experimental and control, the percentage of wrong pre-test responses to an item which changed to right responses on the post-test (W - R). Consider also, for each group, the percentage of right pre-test responses to an item which remained right (R - R) for the post-test. Such percentages have been computed for identical and paraphrased items for each chapter and are tabulated in Tables I, II, III, IV, V, VI, for chapters one, two, four, nine, ten, and for chapters seventeen and eighteen combined. The sign of the difference between the two percentages for an item, a plus sign (+) indicating favor of experimental group, is also tabulated.

It is of interest to test the hypothesis H_o that the median of the differences for a chapter is zero against the alternative hypothesis that the median of the differences is positive. In each instance, (W - R) and (R - R), the number r of positive differences used for the sign test is

TABLE I

PER CENT CHANGE IN RESPONSES FROM PRE-TEST TO POST-TEST, BY ITEM, CHAPTER ONE (N = 128)

Item	Wrong to Right		Sign of Diff	Right remains Right		Sign of Diff
	Control	Exp.		Control	Exp.	
1	90.91	66.67	-	86.96	96.43	+
2	61.11	62.50	+	55.00	90.91	+
3	41.67	57.89	+	79.41	81.48	+
4	37.50	73.33	+	82.00	80.65	-
5	58.33	77.78	+	95.56	97.30	+
6	34.78	61.54	+	77.14	84.85	+
7	60.61	82.61	+	76.00	91.30	+
8	34.62	73.68	+	90.63	92.59	+
9	36.36	56.25	+	80.00	93.33	+
10	33.33	83.33	+	91.11	92.50	+
11	56.25	65.00	+	82.93	92.31	+
12	67.35	71.43	+	77.78	81.82	+
13	25.71	67.86	+	27.27	72.22	+
14	56.52	53.33	-	94.29	93.55	-
15	30.30	82.76	+	80.00	82.35	+
16	40.00	93.33	+	83.72	93.55	+
17	45.45	72.73	+	80.85	74.29	-
18	13.73	88.89	+	57.14	80.00	+
19	4.76	72.73	+	43.75	61.54	+
20	66.67	75.00	+	88.46	84.21	-
21	57.14	63.64	+	90.91	79.17	-
22	85.71	75.00	-	87.76	86.84	-
23	28.95	77.27	+	65.00	79.17	+
24	44.23	55.26	+	83.33	50.00	-
25	54.17	60.00	+	70.59	83.87	+
26	46.67	68.75	+	83.72	96.67	+
27	61.54	82.61	+	90.32	91.30	+
28	48.00	56.52	+	78.79	73.91	-
29	76.47	100.00	+	95.00	91.18	-
30	34.48	47.83	+	81.48	56.52	-
n			30			30
r			27			20
$P(x \geq r) = E(n, r, p)$			0.000			0.049

TABLE II

PER CENT CHANGES IN RESPONSES FROM PRE-TEST TO POST-TEST, BY ITEM, CHAPTER TWO (N = 128)

Item	Wrong to Right Control	Wrong to Right Exp.	Sign of Diff	Right remains Right Control	Right remains Right Exp.	Sign of Diff
1	66.67	85.71	+	100.00	95.00	-
2	88.89	100.00	+	95.83	100.00	+
3	85.00	81.82	-	94.59	86.11	-
4	90.00	83.33	-	93.62	90.24	-
5	82.35	81.82	-	90.00	88.89	-
6	61.54	80.00	+	95.45	100.00	+
7	100.00	90.91	-	96.23	94.44	-
8	63.16	77.42	+	78.95	100.00	+
9	76.47	86.67	+	92.50	90.62	-
10	4.26	80.00	+	40.00	86.36	+
11	35.71	63.16	+	62.07	82.14	+
12	67.57	86.36	+	95.00	100.00	+
13	76.47	80.00	+	100.00	94.59	-
14	40.74	86.96	+	86.67	79.17	-
15	42.11	93.75	+	92.11	100.00	+
16	92.31	87.50	-	95.45	96.77	+
17	82.35	92.86	+	100.00	100.00	
18	87.50	100.00	+	95.12	89.47	-
19	41.18	93.75	+	69.57	90.32	+
20	77.78	75.00	-	100.00	89.74	-
21	80.95	66.67	-	91.67	91.43	-
22	58.82	86.67	+	92.50	93.75	+
23	45.71	88.89	+	81.82	93.10	+
24	76.47	86.67	+	90.00	90.32	+
25	83.33	62.50	-	97.78	92.31	-
26	69.23	88.89	+	86.36	83.78	-
27	40.00	90.91	+	95.74	91.67	-
28	75.00	80.00	+	100.00	96.88	-
29	63.64	75.00	+	86.96	93.55	+
30	---	100.00		---	---	
n			29			29
r			21			13
$P(x \geq r) = E(n, r, p)$			0.012			0.771

TABLE III

PER CENT CHANGE IN RESPONSES FROM PRE-TEST TO POST-TEST, BY ITEM, CHAPTER FOUR (N = 128)

Item	Wrong to Right		Sign of Diff	Right remains Right		Sign of Diff
	Control	Exp.		Control	Exp.	
1	85.71	58.33	-	79.49	71.05	-
2	46.67	69.57	+	92.11	85.19	-
3	100.00	100.00		98.00	100.00	+
4	23.08	63.64	+	85.00	89.74	+
5	54.55	92.00	+	95.00	96.00	+
6	52.94	60.00	+	88.89	87.50	-
7	---	100.00		100.00	100.00	
8	100.00	75.00	-	100.00	100.00	
9	33.33	62.50	+	88.46	80.77	-
10	73.68	75.00	+	88.24	85.29	-
11	81.82	81.82		100.00	100.00	
12	69.57	100.00	+	77.78	100.00	+
13	100.00	66.67	-	100.00	84.09	-
14	34.38	90.32	+	95.24	100.00	+
15	0.00	87.50	+	100.00	95.24	-
16	45.83	62.96	+	65.52	65.22	-
17	40.91	83.33	+	100.00	90.00	-
18	0.00	100.00	+	98.08	97.87	-
19	66.67	100.00	+	100.00	97.67	-
20	85.71	72.73	-	88.89	100.00	+
21	68.00	84.62	+	92.59	91.30	-
22	31.03	87.50	+	70.83	68.00	-
23	54.55	26.67	-	92.86	55.88	-
24	---	---		---	---	
25	---	---		---	---	
26	25.00	89.47	+	76.19	80.00	+
27	28.21	72.97	+	33.33	83.33	+
28	77.78	77.78		90.91	80.00	-
29	48.57	31.58	-	83.33	72.73	-
30	33.33	95.24	+	90.24	100.00	+
n			24			25
r			18			9
$P(x \geq r) = E(n, r, p)$			0.011			0.946

TABLE IV

PER CENT CHANGE IN RESPONSES FROM PRE-TEST TO POST-TEST, BY ITEM, CHAPTER NINE (N = 128)

Item	Wrong to Right Control	Wrong to Right Exp.	Sign of Diff	Right remains Right Control	Right remains Right Exp.	Sign of Diff
1	27.27	85.71	+	63.64	92.00	+
2	24.14	76.92	+	76.92	81.48	+
3	41.38	88.00	+	76.92	78.57	+
4	77.78	84.62	+	82.61	87.50	+
5	50.00	85.71	+	84.85	87.18	+
6	37.04	88.89	+	78.57	96.15	+
7	31.58	100.00	+	80.56	91.67	+
8	54.55	83.33	+	86.36	75.61	-
9	96.43	94.44	-	100.00	97.14	-
10	72.22	76.92	+	81.08	77.50	-
11	26.67	86.36	+	72.00	90.32	+
12	75.00	100.00	+	97.44	92.86	-
13	38.46	90.00	+	90.48	90.91	+
14	47.22	86.36	+	89.47	90.32	+
15	68.00	84.21	+	93.33	79.41	-
16	40.62	82.14	+	82.61	96.00	+
17	60.00	100.00	+	96.00	97.92	+
18	50.00	93.33	+	81.48	86.84	+
19	30.00	100.00	+	91.43	97.83	+
20	46.15	100.00	+	89.66	97.37	+
21	68.75	86.21	+	65.22	79.17	+
22	35.29	58.33	+	95.24	87.10	-
23	47.83	100.00	+	53.12	87.80	+
24	32.00	94.44	+	76.67	91.43	+
25	17.02	58.06	+	62.50	50.00	-
26	---	---		---	---	
27	50.00	69.23	+	95.74	92.50	-
28	75.00	87.50	+	93.62	93.33	-
29	37.50	68.00	+	47.83	71.43	+
30	38.46	44.44	+	90.48	93.18	+
n			29			29
r			28			20
$P(x \geq r) = E(n, r, p)$			0.000			0.031

TABLE V

PER CENT CHANGE IN RESPONSES FROM PRE-TEST TO POST TEST, BY ITEM, CHAPTER TEN (N = 128)

Item	Wrong to Right		Sign of Diff	Right remains Right		Sign of Diff
	Control	Exp.		Control	Exp.	
1	81.08	95.65	+	100.00	100.00	
2	22.73	75.00	+	58.33	81.82	+
3	50.00	80.00	+	89.13	89.80	+
4	43.48	92.86	+	84.85	100.00	+
5	14.58	87.10	+	50.00	91.30	+
6	21.28	62.16	+	66.67	47.06	-
7	63.16	55.56	-	97.30	77.78	-
8	32.50	64.29	+	81.25	80.77	-
9	26.47	81.82	+	59.09	84.38	+
10	12.90	80.00	+	20.00	86.21	+
11	6.45	86.96	+	48.00	80.65	+
12	50.00	93.33	+	97.73	94.87	-
13	42.31	33.33	-	50.00	75.61	+
14	66.67	72.73	+	70.59	75.00	+
15	25.81	71.43	+	64.00	65.38	+
16	100.00	92.31	-	94.12	85.37	-
17	35.14	86.67	+	52.63	91.67	+
18	33.33	73.08	+	78.26	75.00	-
19	40.00	88.89	+	92.16	93.33	+
20	87.50	100.00	+	93.75	95.45	+
21	31.43	77.78	+	57.14	94.44	+
22	25.00	70.97	+	54.17	69.57	+
23	56.67	78.95	+	88.46	94.29	+
24	66.67	70.00	+	97.37	85.29	-
25	78.05	70.59	-	86.67	78.38	-
26	30.95	50.00	+	64.29	66.67	+
27	50.00	100.00	+	92.31	89.80	-
28	62.07	73.08	+	81.48	82.14	+
29	81.82	71.43	-	93.33	85.11	-
30	72.73	93.75	+	95.65	86.36	-
n			30			29
r			25			18
$P(x \geq r) = E(n, r, p)$			0.000			0.132

TABLE VI

PER CENT CHANGE IN RESPONSES FROM PRE-TEST TO POST-TEST, BY ITEM, CHAPTERS 17 and 18 (N = 128)

Item	Wrong to Right		Sign of Diff	Right remains Right		Sign of Diff
	Control	Exp.		Control	Exp.	
1	50.00	100.00	+	97.92	100.00	+
2	72.73	87.50	+	95.74	95.83	+
3	87.50	66.67	-	94.00	94.34	+
4	100.00	---		100.00	98.21	-
5	78.57	80.00	+	93.33	88.57	-
6	59.26	77.78	+	93.55	85.71	-
7	56.25	75.00	+	87.80	93.18	+
8	43.90	76.74	+	68.75	100.00	+
9	42.11	81.25	+	84.21	97.50	+
10	84.62	100.00	+	100.00	95.45	-
11	78.26	88.89	+	97.14	91.49	-
12	85.71	80.00	-	100.00	97.56	-
13	62.07	92.00	+	96.55	100.00	+
14	48.15	42.11	-	80.00	72.22	-
15	73.91	93.33	+	97.14	97.56	+
16	54.55	100.00	+	89.36	93.62	+
17	33.33	100.00	+	89.13	95.74	+
18	72.73	77.78	+	91.67	97.37	+
19	31.25	53.85	+	68.29	55.81	-
20	81.82	100.00	+	89.36	92.16	+
21	80.00	83.33	+	98.11	100.00	+
22	81.82	50.00	-	72.34	86.54	+
23	66.67	100.00	+	93.02	93.48	+
24	85.19	100.00	+	93.55	100.00	+
n		23			24	
r		19			16	
$P(x \geq r) = E(n, r, p)$		0.001			0.076	

recorded. The binomial probability $P(x \geq r) = E(n, r, 1/2)$, that is the probability of at least r successes in n independent trials if the probability of success in one trial is 1/2, is shown (1). Small values of P, tha is $P \leq .05$, lead to rejection of the hypothesis H_o and acceptance of the alternative H_1 supporting the inference that the experimental group is superior.

The experimental group is favored for each of the six chapters when the percentage of wrong responses on the pre-test which changed to right on the post-test (W - R) is the percentage considered. The experimental group is also favored for two of the six chapters, one and nine, when the percentage of right responses on the pre-test which remained right on the post-test (R - R), is considered. The hypothesis under test can not be rejected (five per cent level) for the other four chapters. One may infer that in these four instances either the groups are not different or that the difference is not large enough to show up in a sample of this size.

These statistical tests appear to indicate that individuals in the experimental group who make incorrect responses on the pre-test will change those incorrect responses to correct responses on the post-test (W - R) more frequently than individuals in the control group. For the two chapters where a difference between the two groups on the percentage of correct responses to remain correct (R - R) appears significant (five per cent level) the experimental group is favored.

Analysis of Scores for Individuals

The hypothesis of no difference between the experimental and control groups was also tested using an analysis of covariance technique with scores of individuals. Means for variables considered in the analysis are shown in Table VII for the experimental group, the control group, and the two groups combined. The standard deviations are also shown for the two groups combined. An intercorrelation matrix including all of these variables is presented in Table VIII.

Chapters 1, 2, 4, 9, 10, and 17 and 18 combined were regarded as separate units for the statistical analyses. The hypothesis of no difference between groups, as measured by the chapter pre-test and the chapter post-test, was tested for each chapter. Variables considered in covariance for the analysis of pre-test scores were:

1. Age in years
2. Grade point average
3. Otis Gamma
4. Hours, Psychology
5. Hours, Behavioral Sciences other than Psychology
6. Pre-Test, Course (knowledge of educational psychology)
7. Group
8. Instructor
9. Sex
10. Classification: junior, senior, or other
11. Major Area: elementary, secondary, or other

TABLE VII

MEANS FOR THE EXPERIMENTAL AND CONTROL GROUPS AND THE TWO GROUPS COMBINED WITH STANDARD DEVIATIONS FOR THE COMBINED GROUPS

Variable	Group Means			Std. Deviations
	Exp. N = 62	Control N = 63	Combined N = 125	Groups Combined N = 125
Age, in years	22.952	24.968	23.968	7.237
Grade Point Average	2.814	2.538	2.675	0.660
Otis Gamma	59.177	60.937	60.064	9.484
Hours, Psychology	4.274	3.937	4.104	3.352
Hours, Other Behav. Sci	5.177	5.016	5.096	6.412
Pre-Test, Course	36.387	37.810	37.104	4.722
Ch 1, Pre-Test	16.919	17.524	17.224	3.419
Ch 1, Post-Test	23.113	19.317	21.200	3.831
Ch 2, Pre-Test	21.419	20.016	20.712	3.430
Ch 2, Post-Test	26.548	24.175	25.352	3.353
Ch 4, Pre-Test	16.742	17.698	17.224	3.665
Ch 4, Post-Test	21.823	20.571	21.192	4.775
Ch 9, Pre-Test	19.468	17.302	18.376	4.087
Ch 9, Post-Test	25.161	19.238	22.176	4.383
Ch 10, Pre-Test	18,710	15.365	17.024	3.984
Ch 10, Post-Test	24.113	18.079	21.072	5.059
Ch 17, 18, Pre-Test	43.871	39.905	41.872	6.627
Ch 17, 18, Post-Test	38.839	37.317	38.072	4.758
R - W Gain	10.500	12.286	11.400	5.655
W - W Gain	10.597	29.968	20.360	12.820
W - R Gain	37.258	28.714	32.952	12.007
R - R Gain	80.823	79.175	79.992	24.265
First Mid-Sem. Test	20.597	21.063	20.832	3.291
Second Mid-Sem. Test	30.661	30.048	30.352	4.256
Final Exam	59.032	60.952	60.000	7.987

TABLE VIII

INTERCORRELATION MATRIX (N = 125)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Age, Years	-.18	-.15	-.11	-.09	.11	-.01	-.02	-.02	-.11	.10	-.01	-.08	.04	-.0
(2) Grade Point Average		-.29	.10	.08	-.40	-.20	-.23	-.18	-.09	-.32	-.07	-.15	.04	-.1
(3) Otis Gamma			.01	.10	.46	.36	.18	.27	.15	.33	.20	.27	.06	.1
(4) Hours, Psychology				.22	.06	-.16	-.08	.05	.02	.05	.04	-.04	.04	-.0
(5) Hours, Other Behav. Sci.					.05	.11	-.05	.09	.11	.17	.14	.00	-.06	.0
(6) Pre-Test, Course						.33	.19	.27	.24	.42	.15	.31	.05	.1
(7) Ch 1, Pre-Test							.25	.35	.14	.27	.01	.22	.07	.2
(8) Ch 1, Post-Test								.33	.36	.19	.30	.25	.48	.3
(9) Ch 2, Pre-Test									.47	.25	.23	.37	.27	.3
(10) Ch 2, Post-Test										.25	.18	.33	.30	.5
(11) Ch 4, Pre-Test											.40	.10	-.01	.1
(12) Ch 4, Post-Test												-.08	.18	.0
(13) Ch 9, Pre-Test													.33	.5
(14) Ch 9, Post-Test														.4
(15) Ch 10, Pre-Test														
(16) Ch 10, Post-Test														
(17) Ch 17, 18, Pre-Test														
(18) Ch 17, 18, Post-Test														
(19) R - W Gain														
(20) W - W Gain														
(21) W - R Gain														
(22) R - R Gain														
(23) First Mid-Sem. Test														
(24) Second Mid-Sem. Test														
(25) Final Exam														

Note: $r_{05}(df = 125) = .174$, $r_{01}(df = 125) = .228$.

TABLE VIII

INTERCORRELATION MATRIX (N = 125)

(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	
.02	-.02	-.11	.10	-.01	-.08	.04	-.05	-.06	.06	-.10	.05	.08	-.06	.02	.18	.07	.19	(1)
.23	-.18	-.09	-.32	-.07	-.15	.04	-.14	.03	-.30	-.27	.17	-.02	.24	-.32	-.42	-.26	-.48	(2)
.18	.27	.15	.33	.20	.27	.06	.17	.13	.27	.25	-.23	-.16	-.26	.29	.38	.18	.40	(3)
.08	.05	.02	.05	.04	-.04	.04	-.04	-.03	.10	.06	.08	.03	.09	.03	.00	.10	.08	(4)
.05	.09	.11	.17	.14	.00	-.06	.05	-.05	.01	-.06	.03	.01	-.08	.03	-.13	.13	.00	(5)
.19	.27	.24	.42	.15	.31	.05	.18	.11	.35	.26	-.14	-.10	-.25	.43	.47	.24	.50	(6)
.25	.35	.14	.27	.01	.22	.07	.22	.16	.36	.26	-.01	-.20	-.33	.38	.32	.24	.35	(7)
	.33	.36	.19	.30	.25	.48	.35	.41	.40	.37	-.38	-.57	.19	.38	.32	.26	.22	(8)
		.47	.25	.23	.37	.27	.38	.35	.51	.35	-.10	-.40	-.14	.50	.37	.30	.35	(9)
			.25	.18	.33	.30	.54	.51	.29	.24	-.25	-.48	.16	.52	.09	.17	.27	(10)
				.40	.10	-.01	.18	.12	.38	.31	-.17	-.18	-.23	.39	.21	.40	.38	(11)
					-.08	.18	.00	.30	.09	.13	-.31	-.26	.29	.25	.22	.29	.07	(12)
						.33	.56	.36	.55	.33	.01	-.45	-.35	.41	.18	.09	.34	(13)
							.44	.60	.41	.30	-.36	-.68	.29	.27	.07	.20	.11	(14)
								.49	.53	.27	-.04	-.56	-.11	.54	.10	.15	.21	(15)
									.40	.24	-.35	-.66	.32	.40	.11	.21	.21	(16)
										.60	-.11	-.51	-.29	.52	.30	.38	.40	(17)
											-.32	-.41	-.16	.38	.34	.52	.42	(18)
												.40	.10	.06	-.25	-.25	-.26	(19)
													-.02	-.14	-.14	-.23	-.14	(20)
														.15	-.20	-.01	-.25	(21)
															.33	.37	.46	(22)
																.31	.58	(23)
																	.43	(24)
																		(25)

Three sets of covariates were considered in the analyses of post-test scores. The first set was the same as that used for the pre-test. The second set included all of the first plus the chapter pre-test. The third set was limited to

1. Age in years
2. Grade point average
3. Otis Gamma
4. Pre-Test, Course (knowledge of educational psychology)
5. Pre-Test, Chapter
6. Group
7. Instructor
8. Sex

For each of the four cases the computed regression coefficients, constants, multiple correlation, and appropriate test statistics are presented for each chapter. Summaries of the results for Chapters 1, 2, 4, 9, 10, and 17 and 18 combined are given in Tables IX, X, XI, XII, XIII, and XIV respectively. The value of the test statistic t associated with the group variable indicates the significance of the difference between groups.

The one consistent finding of these analyses is the highly significant (one per cent level) difference between the experimental and control groups as measured by the post-test of chapters one, two, four, nine, and ten. For chapters seventeen and eighteen combined the direction of the difference favors the experimental group in each of the three cases. The group difference is large enough to be significant (five per cent level)

TABLE IX

RESULTS OF ANALYSES OF COVARIANCE OF SCORES FROM
ON CHAPTER ONE

	Pre-Test, Ch 1 (Y)		Post-Test (Y)	
	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t
X_1 Age	$+0.022059X_1$	0.481	$-0.023957X_1$	0.532
X_2 Grade Point Average	$-0.079145X_2$	0.152	$-1.562180X_2$	3.066**
X_3 Otis Gamma	$+0.080421X_3$	2.243*	$+0.031635X_3$	0.899
X_4 Hours, Psychology	$-0.208914X_4$	2.299*	$-0.052100X_4$	0.584
X_5 Hours, Other Behav. Sci.	$+0.104440X_5$	2.069*	$-0.056180X_5$	1.134
X_6 Pre-Test, Course	$+0.139066X_6$	1.926	$+0.117266X_6$	1.654
X_7 Pre-Test, Chapter 1				
Group - if experimental	-0.246245	0.828	+2.298622	7.872**
- if control	+0.246245		-2.298622	
Instructor - if A	-0.524412	1.783	+0.626112	2.169*
- if B	+0.524412		-0.626112	
Sex - if male	-0.307583	0.840	+0.241344	0.671
- if female	+0.307583		-0.241344	
Classification - if junior	+0.468956	F(2, 111) = 0.454	-0.424262	F(2, 111) = 0.452
- if senior	-0.174182		-0.009703	
- if other	-0.294774		+0.433965	
Major Area - if elementary	-0.125743	F(2, 111) = 1.819	-0.014438	F(2, 111) = 0.109
- if secondary	+0.804009		+0.191338	
- if other	-0.678266		-0.176900	
Constant	+6.666168		+20.401504	
Multiple Correlation, R	0.513	F(13, 111) = 3.058**	0.660	F(13, 111) = 6.575**

* Significant, five per cent level
** Significant, one per cent level

[1]The test statistic is t except where F is shown.

TABLE IX

ES OF COVARIANCE OF SCORES FROM TESTS BASED ON CHAPTER ONE

Post-Test (Y)		Post-Test (Y)		Post-Test (Y)			
gression efficients Constants h R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t		
023957 X_1	0.532	-0.030393 X_1	0.703	-0.009159 X_1	0.226		
562180 X_2	3.066**	-1.539091 X_2	3.149**	-1.697282 X_2	3.702**		
031635 X_3	0.899	+0.008173 X_3	0.237	+0.009303 X_3	0.279		
052100 X_4	0.584	+0.008848 X_4	0.101				
056180 X_5	1.134	-0.086650 X_5	1.790				
117266 X_6	1.654	+0.076695 X_6	1.110	+0.067307 X_6	1.003		
		+0.291740 X_7	3.265**	+0.262888 X_7	3.136**		
298622	7.872**	+2.370462	8.438**	+2.388529	8.767**		
298622		-2.370462		-2.388529			
626112	2.169*	+0.779105	2.775**	+0.671788	2.535*		
626112		-0.779105		-0.671788			
626112		-0.779105		-0.671788			
241344	0.671	+0.331078	0.957	+0.445684	1.514		
241344		-0.331078		-0.445684			
424262	F(2, 111) = 0.452	-0.561075	F(2, 110) = 0.806				
009703		+0.041113					
433965		+0.519962					
014438	F(2, 111) = 0.109	+0.022246	F(2, 110) = 0.006				
191338		-0.043224					
176900		+0.020978					
401504		+18.456715		+18.456871			
660	F(13, 111) = 6.575**	0.696	F(14, 110) = 7.399**	0.683	F(8, 116) = 12.645**		

TABLE X

RESULTS OF ANALYSES OF COVARIANCE OF SCORES F
ON CHAPTER TWO

	Pre-Test, Ch 2 (Y)		Post-Test (Y)	
	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t
X_1 Age	$+0.036030X_1$	0.794	$-0.019211X_1$	0.441
X_2 Grade Point Average	$-0.497474X_2$	0.969	$-0.157141X_2$	0.318
X_3 Otis Gamma	$+0.041409X_3$	1.167	$-0.010086X_3$	0.296
X_4 Hours, Psychology	$-0.018667X_4$	0.208	$-0.039520X_4$	0.457
X_5 Hours, Other Behav. Sci.	$+0.067913X_5$	1.360	$+0.073035X_5$	1.522
X_6 Pre-Test, Course	$+0.115482X_6$	1.616	$+0.188264X_6$	2.742**
X_7 Pre-Test, Chapter Two				
Group - if experimental	+0.692112	2.351*	+1.185400	4.191**
- if control	-0.692112		-1.185400	
Instructor - if A	-0.199648	0.686	+0.014784	0.053
- if B	+0.199648		-0.014784	
Sex - if male	-0.924628	2.552*	-0.784044	2.282*
- if female	+0.924628		+0.784044	
Classification - if junior	-0.601485	F(2, 111) = 2.086	-0.073553	F(2, 111) = 0.03
- if senior	+1.191043		+0.137839	
- if other	-0.586558		-0.064286	
Major Area - if elementary	+0.144629	F(2, 111) = 3.034	-0.867382	F(2, 111) = 4.440*
- if secondary	+0.973214		+1.048572	
- if other	-1.117843		-0.181190	
Constant	+13.912987		+19.289845	
Multiple Correlation, R	0.533	F(13, 111) = 3.390**	0.555	F(13, 111) = 3.803**

* Significant, five per cent level
** Significant, one per cent level

[1]The test statistic is t except where F is shown.

TABLE X

SES OF COVARIANCE OF SCORES FROM TESTS BASED ON CHAPTER TWO

Post-Test (Y)		Post-Test (Y)		Post-Test (Y)		
egression oefficients d Constants ith R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t	
0.019211 X_1	0.441	-0.030506 X_1	0.735	-0.034426 X_1	0.867	
0.157141 X_2	0.318	-0.001187 X_2	0.003	-0.122987 X_2	0.275	
0.010086 X_3	0.296	-0.023068 X_3	0.708	-0.012484 X_3	0.389	
0.039520 X_4	0.457	-0.033668 X_4	0.410			
0.073035 X_5	1.522	-0.051745 X_5	1.126			
0.188264 X_6	2.742**	+0.152062 X_6	2.305*	+0.145740 X_6	2.227*	
		+0.313493 X_7	3.620**	+0.340363 X_7	4.091**	
.185400 .185400	4.191**	+0.968427 -0.968427	3.519**	+1.021390 -1.021390	3.728**	
.014784 .014784	0.053	+0.077372 -0.077372	0.291	+0.193818 -0.193818	0.753	
.784044 .784044	2.252*	-0.494180 +0.494180	1.452	-0.156423 +0.156423	0.534	
.073553 .137839 .064286	F(2, 111) = 0.031	+0.115948 -0.235544 +0.119596	F(2, 110) = 0.093			
.867382 .048572 .181190	F(2, 111) = 4.440*	-0.912722 +0.743476 +0.169246	F(2, 110) = 3.458*			
.289845		+14.928217		+14.754215		
.555	F(13, 111) = 3.803**	0.618	F(14, 110) = 4.852**	0.580	F(8, 116) =	7.360**

TABLE XI

RESULTS OF ANALYSES OF COVARIANCE OF TEST SCORE ON CHAPTER FOUR

	Pre-Test, Ch 4 (Y)			Post-Test (Y)		
	Regression Coefficients and Constants With R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t
X_1 Age	+0.033132X_1		0.722	+0.008715X_1		0.816
X_2 Grade Point Average	-0.371540X_2		0.715	-0.208739X_2		0.393
X_3 Otis Gamma	+0.061333X_3		1.710	+0.075002X_3		2.045*
X_4 Hours, Psychology	+0.008901X_4		0.098	+0.123920X_4		1.333
X_5 Hours, Other Behav. Sci.	+0.042287X_5		0.837	-0.060926X_5		1.180
X_6 Pre-Test, Course	+0.227459X_6		3.148**	+0.098817X_6		1.337
X_7 Pre-Test, Chapter 4						
Group - if experimental	-0.184391		0.619	+1.170785		3.846**
- if control	+0.184391			-1.170785		
Instructor - if A	+0.534110		1.815	+3.470624		11.534**
- if B	-0.534110			-3.470624		
Sex - if male	-0.901798		2.461*	-0.135294		0.361
- if female	+0.901798			+0.135294		
Classification - if junior	-0.469349	F(2, 111) =	2.850	-0.489762	F(2, 111) =	1.699
- if senior	-1.026324			-0.683687		
- if other	+1.495673			+1.173449		
Major Area - if elementary	-0.970839	F(2, 111) =	2.151	-0.059671	F(2, 111) =	0.663
- if secondary	+0.085115			-0.473356		
- if other	+0.885724			+0.533027		
Constant	+5.173693			+13.332459		
Multiple Correlation, R	0.599	F(13, 111) =	4.771**	0.778	F(13, 111) =	13.067**

* Significant, five per cent level
** Significant, one per cent level

[1]The test statistic is t except where F is shown.

TABLE XI

S OF COVARIANCE OF TEST SCORES FROM TESTS BASED ON CHAPTER FOUR

Post-Test (Y)		Post-Test (Y)		Post-Test (Y)	
ression fficients Constants h R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t
$008715X_1$	0.816	$-0.001798X_1$	0.040	$+0.014184X_1$	0.332
$208739X_2$	0.393	$-0.090840X_2$	0.179	$-0.132752X_2$	0.275
$075002X_3$	2.045*	$+0.055540X_3$	1.565	$+0.043426X_3$	1.270
$123920X_4$	1.333	$+0.121096X_4$	1.364		
$060926X_5$	1.180	$-0.074345X_5$	1.503		
$098817X_6$	1.337	$+0.026639X_6$	0.362	$+0.019889X_6$	0.279
		$+0.317325X_7$	3.424**	$+0.325400X_7$	3.725**
170785 170785	3.846**	+1.229297 -1.229297	4.222**	+1.200902 -1.200902	4.221**
470624 470624	11.534**	+3.301137 -3.301137	11.322**	+3.192048 -3.192048	11.331**
470624		-3.301137		-3.192048	
135294 135294	0.361	+0.150870 -0.150870	0.411	+0.033636 -0.033636	0.108
489782 683687 173449	F(2, 111) = 1.699	-0.340826 -0.358009 +0.698835	F(2, 110) = 0.651		
059671 473356 533027	F(2, 111) = 0.663	+0.248401 -0.500365 +0.251964	F(2, 110) = 0.776		
332459		+11.690723		+12.044281	
778	F(13, 111) = 13.067**	0.802	F(14, 110) = 14.143**	0.790	F(8, 116) = 24.142**

TABLE XII

RESULTS OF ANALYSES OF COVARIANCE OF TEST SCORE ON CHAPTER NINE

	Pre-Test, Ch 9 (Y)			Post-Test (Y)		
	Regression Coefficients and Constants With R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t
X_1 Age	$-0.017438 X_1$		0.344	$+0.108047 X_1$		2.323*
X_2 Grade Point Average	$-0.308831 X_2$		0.539	$-0.082441 X_2$		0.157
X_3 Otis Gamma	$+0.061130 X_3$		1.544	$+0.040125 X_3$		1.103
X_4 Hours, Psychology	$-0.144070 X_4$		1.436	$+0.035491 X_4$		0.385
X_5 Hours, Other Behav. Sci.	$+0.068286 X_5$		1.225	$-0.024009 X_5$		0.469
X_6 Pre-Test, Course	$+0.222782 X_6$		2.793**	$+0.075419 X_6$		1.030
X_7 Pre-Test, Chapter 9						
Group - if experimental	+1.097954		3.342**	+3.152686		10.448**
- if control	-1.097954			-3.152686		
Instructor - if A	-1.474557		4.540**	+0.199873		0.670
- if B	+1.474557			-0.199873		
Sex - if male	-0.367755		0.909	-0.495716		1.334
- if female	+0.367755			+0.495716		
Classification - if junior	+0.114852	F(2, 111) =	0.422	+0.215396	F(2, 111) =	0.596
- if senior	+0.507388			+0.477845		
- if other	-0.622240			-0.693241		
Major Area - if elementary	-0.291839	F(2, 111) =	1.207	-0.826324	F(2, 111) =	1.769
- if secondary	+0.715196			+0.459673		
- if other	-0.423357			+0.366651		
Constant	+7.697327			+14.355523		
Multiple Correlation, R	0.609	F(13, 111) =	5.046**	0.734	F(13, 111) =	9.983**

* Significant, five per cent level
** Significant, one per cent level

[1]The test statistic is t except where F is shown.

TABLE XII

OF COVARIANCE OF TEST SCORES FROM TESTS BASED ON CHAPTER NINE

Post-Test (Y)			Post-Test (Y)			Post-Test (Y)		
gression efficients Constants h R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t
108047 X_1		2.323*	+0.110919 X_1		2.412*	+0.105787 X_1		2.427*
082441 X_2		0.157	-0.031580 X_2		0.061	-0.020786 X_2		0.042
040125 X_3		1.103	+0.030058 X_3		0.828	+0.031191 X_3		0.884
035491 X_4		0.385	+0.059218 X_4		0.644			
024009 X_5		0.469	-0.035255 X_5		0.692			
075419 X_6		1.030	+0.038729 X_6		0.517	+0.045043 X_6		0.614
			+0.164690 X_7		1.912	+0.170682 X_7		2.036*
152686		10.448**	+2.971864		9.499**	+2.944344		9.569**
152686			-2.971864			-2.944344		
199873		0.670	+0.442717		1.379	+0.408903		1.340
199873			-0.442717			-0.408903		
495716		1.334	-0.435151		1.181	-0.316557		1.003
495716			+0.435151			+0.316557		
215396	F(2, 111) =	0.596	+0.196481	F(2, 110) =	0.439			
477845			+0.394284					
693241			-0.590765					
826324	F(2, 111) =	1.769	-0.778262	F(2, 110) =	1.465			
459673			+0.341888					
366651			+0.436374					
355523			+13.087854			+12.930513		
734	F(13, 111) =	9.983**	0.744	F(14, 110) =	9.753**	0.728	F(8, 116) =	16.389**

TABLE XIII

RESULTS OF ANALYSES OF COVARIANCE OF TEST SCORE ON CHAPTER TEN

	Pre-Test, Ch 10 (Y)			Post-Test (Y)		
	Regression Coefficients and Constants With R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t
X_1 Age	$-0.004099X_1$		0.082	$+0.053960X_1$		0.937
X_2 Grade Point Average	$-0.843224X_2$		1.495	$+0.014908X_2$		0.023
X_3 Otis Gamma	$+0.026406X_3$		0.678	$+0.053744X_3$		1.193
X_4 Hours, Psychology	$-0.086460X_4$		0.876	$-0.033262X_4$		0.291
X_5 Hours, Other Behav. Sci.	$+0.091158X_5$		1.662	$-0.033407X_5$		0.527
X_6 Pre-Test, Course	$+0.120386X_6$		1.534	$+0.145073X_6$		1.599
X_7 Pre-Test, Chapter 10						
Group - if experimental	+1.753802		5.426**	+3.191692		8.540**
- if control	-1.753802			-3.191692		
Instructor - if A	-0.841574		2.634**	+0.709682		1.921
- if B	+0.841574			-0.709682		
Sex - if male	-0.265998		0.668	-0.318903		0.693
- if female	+0.265998			+0.318903		
Classification - if junior	+0.239100	F(2, 111) =	0.146	+0.755304	F(2, 111) =	0.893
- if senior	+0.076945			+0.042480		
- if other	-0.316045			-0.797784		
Major Area - if elementary	-0.988190	F(2, 111) =	3.992*	-0.530785	F(2, 111) =	2.105
- if secondary	+1.107179			+1.055758		
- if other	-0.118989			-0.524973		
Constant	+12.884604			+10.632096		
Multiple Correlation, R	0.600	F(13, 111) =	4.804**	0.685	F(13, 111) =	7.551

* Significant, five per cent level
** Significant, one per cent level

[1]The test statistic is t except where F is shown.

TABLE XIII

F COVARIANCE OF TEST SCORES FROM TESTS BASED ON CHAPTER TEN

Post-Test (Y)		Post-Test (Y)		Post-Test (Y)	
ression ficients Constants R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R	Test Statistic[1] t
$053960X_1$	0.937	$+0.055355X_1$	1.001	$+0.038843X_1$	0.739
$014908X_2$	0.023	$+0.301713X_2$	0.477	$+0.336564X_2$	0.561
$053744X_3$	1.193	$+0.044763X_3$	1.033	$+0.046812X_3$	1.112
$033262X_4$	0.291	$-0.003855X_4$	0.035		
$033407X_5$	0.527	$-0.064413X_5$	1.045		
$145073X_6$	1.599	$+0.104126X_6$	1.183	$+0.108729X_6$	1.257
		$+0.340130X_7$	3.228**	$+0.359422X_7$	3.558**
191692	8.540**	+2.595172	6.430**	+2.580851	6.469**
191692		-2.595172		-2.580851	
709682	1.921	+0.995926	2.724**	+0.906946	2.607*
709682		-0.995926		-0.906946	
818903	0.693	-0.228429	0.516	-0.290007	0.761
818903		+0.228429		+0.290007	
755304	F(2, 111) = 0.892	+0.673979	F(2, 110) = 0.753		
942480		+0.016309			
797784		-0.690288			
530785	F(2, 111) = 2.105	-0.194672	F(2, 110) = 0.845		
955758		+0.679173			
524973		-0.484501			
632096		+6.249661		+6.159346	
685	F(13, 111) = 7.551	0.718	F(14, 110) = 8.351**	0.698	F(8, 116) = 13.767**

TABLE XIV

RESULTS OF ANALYSES OF COVARIANCE OF TEST SCOR
ON CHAPTERS SEVENTEEN AND EIGHT

	Pre-Test, Ch 17 and 18 (Y)			Post-Test (Y)		
	Regression Coefficients and Constants With R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t
X_1 Age	$+0.082697X_1$		1.050	$-0.100406X_1$		1.533
X_2 Grade Point Average	$-2.299444X_2$		2.580*	$-2.019252X_2$		2.723**
X_3 Otis Gamma	$+0.080927X_3$		1.315	$+0.043727X_3$		0.854
X_4 Hours, Psychology	$+0.153553X_4$		0.984	$+0.106760X_4$		0.823
X_5 Hours, Other Behav. Sci.	$+0.067815X_5$		0.783	$-0.043243X_5$		0.600
X_6 Pre-Test, Course	$+0.306502X_6$		2.472*	$+0.139424X_6$		1.352
X_7 Pre-Test, Chapters 17 and 18						
Group - if experimental	+2.272541		4.449**	+1.046888		2.463*
- if control	-2.272541			-1.046888		
Instructor - if A	-1.672971		3.313**	-0.185211		0.441
- if B	+1.672971			+0.185211		
Sex - if male	-0.607867		0.967	+0.180122		0.344
- if female	+0.607867			-0.180122		
Classification - if junior	+0.064862	F(2, 111) =	0.006	-0.584073	F(2, 111) =	1.002
- if senior	+0.041414			+1.199777		
- if other	-0.106276			-0.615704		
Major Area - if elementary	-0.698342	F(2, 111) =	2.999	-0.139703	F(2, 111) =	0.479
- if secondary	+1.754919			+0.590348		
- if other	-1.056577			-0.450645		
Constant	+28.279186			+38.100548		
Multiple Correlation, R	0.650	F(13, 111) =	6.240**	0.474	F(13, 111) =	2.471**

* Significant, five per cent level
** Significant, one per cent level

[1]The test statistic is t except where F is shown.

TABLE XIV

S OF COVARIANCE OF TEST SCORES FROM TESTS BASED
HAPTERS SEVENTEEN AND EIGHTEEN

Post-Test (Y)			Post-Test (Y)			Post-Test (Y)		
gression efficients d Constants ith R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t	Regression Coefficients and Constants With R		Test Statistic[1] t
.100406 X_1		1.533	-0.135635 X_1		2.388*	-0.122735 X_1		2.293*
.019252 X_2		2.723**	-1.039701 X_2		1.578	-0.944291 X_2		1.527
.043727 X_3		0.854	+0.009252 X_3		0.208	+0.011478 X_3		0.266
.106760 X_4		0.823	+0.041347 X_4		0.368			
.043243 X_5		0.600	-0.072132 X_5		1.156			
.139424 X_6		1.352	+0.008856 X_6		0.097	+0.016942 X_6		0.189
			+0.425995 X_7		6.252**	+0.419045 X_7		6.374**
.046888		2.463*	+0.078797		0.198	+0.060278		0.154
.046888			-0.078797			-0.060278		
.185211		0.441	+0.527465		1.388	+0.369803		1.018
.185211			-0.527465			-0.369803		
.180122		0.344	+0.439070		0.968	+0.464416		1.200
.180122			-0.439070			-0.464416		
.584073	F(2, 111) =	1.002	-0.611704	F(2, 110) =	1.333			
.199777			+1.182135					
.615704			-0.570431					
.139703	F(2, 111) =	0.479	+0.157787	F(2, 110) =	0.066			
.590348			-0.157239					
.450645			-0.000548					
.100548			+26.055771			+34.704487		
0.474	F(13, 111) =	2.471**	0.654	F(14, 110) =	5.873**	0.634	F(8, 116) =	9.771**

with the first set of covariates considered but not with the other two. It must be noted here that only 24 of the 49 items are identical or paraphrased whereas in the other chapters all 30 items are identical.

Another hypothesis, tested in connection with the analyses of scores, is that the coefficients for the covariates

1. Hours, Psychology
2. Hours, Behavioral Sciences other than Psychology
3. Classification: junior, senior, or other
4. Major Area: elementary, secondary, or other

in the regression equation, when considered simultaneously, are not significantly different from zero. The computed values of F to test the hypothesis for each of the various chapter post-tests are:

Chapter	F
1	0.681
2	1.337
4	0.929
9	0.955
10	1.067
17 and 18	0.806

The hypothesis can not be rejected in any case. One may infer that these four variables may be omitted from the set of covariates used to predict the post-test scores.

The scores from the two mid-semester tests and the final examination were analyzed by the same technique. The covariates for each of

the three cases were:

1. Age in years
2. Grade point average
3. Otis Gamma
4. Hours, Psychology
5. Hours, Behavioral Sciences other than Psychology
6. Pre-Test, Course (knowledge of educational psychology)
7. Group
8. Instructor
9. Sex
10. Classification: junior, senior, or other
11. Major Area: elementary, secondary, or other

The results of these analyses are presented in Table XV. No significant (five per cent level) difference was found between the experimental and control groups on the scores of the mid-semester tests or on the final examination.

The last four sets of scores used as a basis for testing the hypothesis of no difference between the experimental and control groups and analyzed by the same technique were:

1. Number of right responses on chapter pre-tests changed to wrong responses (R - W) on chapter post-tests (gain score).
2. Number of wrong responses on chapter pre-tests to remain wrong responses (W - W) on chapter post-tests (gain score).
3. Number of wrong responses on chapter pre-tests to change to

TABLE XV

RESULTS OF ANALYSES OF COVARIANCE OF SCOR
TESTS AND THE FINAL EXAMIN

	First Mid-Sem. Test (Y)		Second Mi
	Regression Coefficients and Constants With R	Test Statistic[1] t	Regression Coefficients and Constants With R
X_1 Age	+0.027151 X_1	0.687	+0.010588 X_1
X_2 Grade Point Average	-1.255203 X_2	2.806**	-1.462246 X_2
X_3 Otis Gamma	+0.069952 X_3	2.264*	+0.017494 X_3
X_4 Hours, Psychology	+0.045812 X_4	0.585	+0.162251 X_4
X_5 Hours, Other Behav. Sci.	-0.101489 X_5	2.334*	+0.031408 X_5
X_6 Pre-Test, Course	+0.195801 X_6	3.146**	+0.120339 X_6
Group - if experimental	+0.241243	0.941	+0.613988
- if control	-0.241243		-0.613988
Instructor - if A	+0.333544	1.316	+0.651995
- if B	-0.333544		-0.651995
Sex - if male	+0.052258	0.166	+0.107614
- if female	-0.052258		-0.107614
Classification - if junior	-1.156505	F(2, 111) = 4.134*	-0.455711
- if senior	+0.992320		-0.657315
- if other	+0.164185		+1.113026
Major Area - if elementary	+0.221905	F(2, 111) = 0.265	-0.033066
- if secondary	-0.211625		+0.565930
- if other	-0.010280		-0.532864
Constant	+13.096011		+27.681465
Multiple Correlation, R	0.640	F(13, 111) = 5.934**	0.434

* Significant, five per cent level
** Significant, one per cent level

[1] The test statistic is t except where F is shown.

TABLE XV

OF COVARIANCE OF SCORES FROM MID-SEMESTER
S AND THE FINAL EXAMINATION

) est tatistic[1] t	Second Mid-Sem. Test (Y) Regression Coefficients and Constants With R	 Test Statistic[1] t	Final Examination (Y) Regression Coefficients and Constants With R	 Test Statistic[1] t
0.687	$+0.010588X_1$	0.177	$+0.158250X_1$	1.688
2.806**	$-1.462246X_2$	2.155*	$-3.717018X_2$	3.502**
2.264*	$+0.017494X_3$	0.373	$+0.164407X_3$	2.243*
0.585	$+0.162251X_4$	1.366	$+0.175269X_4$	0.944
2.334*	$+0.031408X_5$	0.476	$+0.033713X_5$	0.327
3.146**	$+0.120339X_6$	1.275	$+0.412617X_6$	2.795**
0.941	+0.613988 -0.613988	1.579	-0.127015 +0.127015	0.209
1.316	+0.651995 -0.651995	1.696	-1.142987 +1.142987	1.901
0.166	+0.107614 -0.107614	0.225	-0.611894 +0.611894	0.817
4.134*	-0.455711 -0.657315 +1.113026	F(2, 111) =	0.935	-1.272465 +1.971869 -0.699404	F(2, 111) =	1.507
0.265	-0.033066 +0.565930 -0.532864	F(2, 111) =	0.538	+0.297336 +0.629633 -0.926969	F(2, 111) =	0.375
	+27.681465			+40.478138		
5.934**	0.434	F(13, 111) =	1.983*	0.660	F(13, 111) =	6.605**

right responses (W - R) on chapter post-tests (gain score).

4. Number of right responses on chapter pre-tests to remain right (R - R) on chapter post-tests (gain score).

(It should be noted that the list does not include a count of items for which no response was made, however, the groups were not significantly (five per cent level) different on this score. The dependence between scores should also be noted.)

The covariates used in the analysis were:

1. Age in years
2. Grade point average
3. Otis Gamma
4. Hours, Psychology
5. Hours, Behavioral Sciences other than Psychology
6. Pre-Test, Course (knowledge of educational psychology)
7. Instructor
8. Sex
9. Classification: junior, senior, or other
10. Major Area: elementary, secondary, or other

The results are summarized in Table XVI.

The two groups, experimental and control, are significantly (one per cent level) different as measured by the (R - W) score, the (W - W) score and the (W - R) score. The difference in each case favors the experimental group. The difference between the two groups is not significant (five per cent level) for the (R - R) score although the difference

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favors the experimental group. These results obtain in spite of the fact that the experimental group had on the average fewer wrong responses (47.855 compared to 58.683) and approximately the same number of right responses (91.323 compared to 91.460) on the pre-tests. These results appear to be consistent with the belief that individuals in the experimental group had a better chance than individuals in the control group to change wrong responses on the pre-test to right responses on the post-test while at the same time retaining right responses equally well.

Student Attitudes

During both semesters questionnaires were circulated to students in all sections of the course to discover attitudes about the learning exercises, the mode of responding to them, and the frequency of their use. The overwhelming finding is that the students like the learning exercises in connection with readings and discussion. The few negative attitudes reflect a confusion between multiple-choice items as learning exercises and as tests. The format of multiple-choice items perhaps leads to the confusion. Students are familiar with multiple-choice tests and carry the test set or attitude into the less emotionally charged learning situation. Hence, some anxiety was aroused initially. After students were reassured that these were truly learning exercises and not tests, the attitudes became more favorable. Students were graded on the mid-semester tests and the final examination. Other factors at the discretion of the instructor entered into the actual determination of the course grade.

V. Conclusions and Implications

1. The experimental group, which received the combination of immediate knowledge of results and awareness of right as right and wrong as wrong, makes significantly (one per cent level) higher scores on the chapter post-tests than the control group when the items on the post-tests are identical (but rearranged) items of the pre-test.

This conclusion indicates that specific knowledge can be learned by adjunct auto-instructional items of the type developed on this project. It adds additional evidence to the rather generally accepted notion that overt responding is not a necessary condition of learning as was so adamantly stated in earlier discussions of self-instructional theory.

2. The two groups do not appear significantly different as measured by mid-semester tests or the final examination.

Apparently the students were not able in this situation to generalize their knowledge to new examples which appeared on the mid-semester tests and the final examination. One might infer that the learning exercises were too specific and that generalizations or principles were themselves taught as specific bits of knowledge. Hence, one could not expect transfer to new problems in the absence of a concerted effort to teach for transfer. This transfer problem needs continued investigation. It is a problem not only in this type of auto-instruction but has been a problem in typical programed instruction.

Another possible interpretation of the above is that a stimulus-response theory is a fairly adequate basis for describing how specific

bits of knowledge are learned, but is a totally inadequate theory for describing how persons learn to attack new problems or to generalize to broader applications. Perhaps additional research could be directed toward the development of a theory to describe how an attitude of inquiry is developed. Such an attitude might lead to wider transfer of specific knowledge.

There seems to be too much emphasis upon the learning of answers to questions and not upon how to ask questions. This latter idea may be the key to the transfer problem.

3. Individuals in the experimental group appear to change incorrect responses on the pre-tests to correct responses on the post-tests more frequently than individuals in the control group. At the same time the two groups appear to retain right responses as right equally well.

4. The four variables (1) hours in psychology, (2) hours in behavioral sciences other than psychology, (3) classification (junior, senior, other), and (4) major area (elementary, secondary, other) are not significant as a group when in concomitant variation in the manner considered.

BIBLIOGRAPHY

1. Tables of the cumulative binomial probability distribution. Cambridge: 1955, Harvard University Press.

2. Baller, Warren R. Readings in the psychology of human growth and development. New York: 1962, Holt, Rinehart and Winston, Inc.

3. Cronbach, Lee J. Educational Psychology (Second Edition). New York: 1962, Harcourt, Brace and World, Inc.

4. Jones, Robert Stewart. Integration of instructional with self-scoring measuring procedures. Doctoral dissertation, 1950, The Ohio State University.

5. Kendall, Maurice G. and Stuart, Alan. The advanced theory of statistics, volume 2, London: 1961, Charles Griffin and Company, Limited.

6. Pressey, Sidney L. Basic unresolved teaching machine problems. Theory into Practice, 1962, 1, 30-37.

7. Pressey, Sidney L. Teaching machine (and learning theory) crisis. Journal of Applied Psychology, 1963, 47, 1-6.

8. Pressey, Sidney L. A puncture in the huge "programing" boom? Teachers College Record, 1964, 65, 413-418.

9. Pressey, Sidney L. and Kinzer, John R. Auto-elucidation without programing. Psychology in the Schools, 1964, 1, #4.

10. Silberman, H. F. Self-instructional devices and programed materials. Review of Educational Research, 1962, 32, 179-193.

11. Stewart, J. Richard. Analysis of variance by regression methods. Unpublished Master of Science thesis, 1962, The Ohio State University.

A. Sample Auto-Instructional Exercise and Directions

Directions: Write on the "response card" your name, the instructor's name, the date and class hour (in the course space). Then read the first question below. If you think answer "a" is right, erase the first circle in the first line to see if there is an "R" underneath. If not, consider "b" or "c" and try again. Find the right (R) answer to each question. Your error score is your number of wrong erasures. This is not primarily a test but an aid in helping you learn.

1. Which of the following is a value assumption? (a) Effective instructional materials place more of the burden of learning on the shoulders of the learner. (b) Most high-school students should study mathematics in order to understand the importance of mathematics in our culture. (c) Both aptitude tests and interest inventories are of value in vocational guidance.

2. In a correlational study, the investigator (a) compares the differences within a group on one variable with differences on another variable; (b) starts with a group that is initially homogeneous on a variable being studied; (c) creates, and then measures, a difference between two groups.

3. The value of the course in educational psychology to the teacher is to be judged by the extent to which (a) it teaches true and important facts about human nature; (b) the teacher comes to understand the educational process; (c) it describes effective classroom practices that the teacher can adopt or adapt.

4. To which of these statements (adapted from Higbet) would the contemporary educational psychologist object? (a) It is dangerous to apply the aims of science to individuals. (b) Teaching involves emotions. (c) Teaching is not like inducing a chemical reaction: it is much more like painting a picture.

5. Before psychological studies had their influence, the teaching of reading (a) was generally based on carefully evaluated experience with different methods; (b) was based on the belief that the reader reacts to details rather than to patterns; (c) emphasized interpretation rather than sound-symbol associations.

6. Established educational practices have generally been (a) based on value assumptions rather than empirical assumptions; (b) derived from psychological studies; (c) derived from conditions existing at the time they were introduced.

B. Trainer-Tester Response Card